classroom group. Low or negligible correlations were observed between programed word gain and mental age, with r's of .20, .03, and .29 for the multiple choice, the keyboard, and the classroom groups respectively. Marked relationship was shown, however, between words known prior to the start of instruction and ability to profit from instruction. For the multiple choice group and r of .80 was shown, for the keyboard group .72, and for the classroom group .65.

Correlation between these variables were also run for the institutional sample. Results are given in Table 8. Since there were 3

TABLE 8
RELATIONSHIPS BETWEEN PROGRAMED WORD GAIN
& RELATED VARIABLES

B. INSTITUTIONAL GROUP

	PROGRAMED WORD GAIN		
	Multiple Choice	Keyboard	Classroom
Chronological Age	.75	.38	.26
Mental Age	.42	.22	.26
Programed Words Known on Pre-Test	.42	.57	.51

female subjects per method group among the institutional group subjects, no calculation was done for sex. With the institutional group, chronological age showed a marked relationship to ability of the multiple choice group to profit from instruction. However, only low correlational relationships were shown for the keyboard and the classroom groups, with r's of .38 and .26 respectively. Mental age

showed a moderate correlation with programed word gain for the multiple choice group, but low order relationships were obtained for gains for the keyboard group and the classroom group. As with the public schools group, the number of programed words known on pre-testing was the best single predictor of ability to profit from instruction. Moderate correlational relationships were shown, with an r of .42 for the multiple choice group, an r of .57 for the keyboard group, and an r of .51 for the classroom group.

Correlation With Programed Spelling Word Gain

Correlations were run between the number of programed spelling words learned over the pre-instructional to post-instructional period and the variables of sex, chronological age, mental age, programed words known on pre-testing, and the number of programed words learned over the pre-instructional to post-instructional period. Results for the public schools group are shown in Table 9. On the multiple choice method, sex appeared to have almost negligible relationship to ability to learn spelling; and only low relationships were shown for the keyboard and the classroom groups. For both the multiple choice and the keyboard method, girls tended to learn the spelling words more readily than boys. For the classroom group, boys tended to learn spelling words more readily than girls. Ability to learn the programed spelling words was negatively correlated with chronological age for both experimental methods, but showed a low order positive correlation of .25 for the classroom group. A similar situation was obtained for mental age with negative low order correlations for both multiple choice and keyboard groups. For the classroom group, negilgible relationship existed, with an r of .04. The programed words known on pre-testing tended to be a better predictor. A low order relationship was shown between the number of words known prior to instruction and ability to learn spelling for

TABLE 9

RELATIONSHIPS BETWEEN PROGRAMED SPELLING WORD GAIN & RELATED VARIABLES

A. PUBLIC SCHOOLS GROUP

	PROGRAMED SPELLING WORDS KNOWN		
	Multiple Choice	Keyboard	Classroom
Sex	.07	.29	.21
Chronological Age	-.26	-.09	.25
Mental Age	-.34	-.17	.04
Programed Words Known on Pre-Test	.29	.41	.55
Programed Word Gain Pre-Test to Post-Test	.51	.56	.46

the multiple choice group, with an r of .29. Correlations of .41 and .55 were shown for the keyboard group and for the classroom group respectively. A moderate relationship exists between the number of programed words learned over the pre-instructional to post-instructional period and the number of spelling words learned. For the multiple choice group this relationship was .51, for the keyboard group .56, and for the classroom group .46.

Similar r's were run with the institutional subjects. The results are shown in Table 10. Chronological age appeared to be a better predictor for the institutional subjects than for the public schools subjects. For the multiple choice method, a low but substantial relationship of .40 existed; for the keyboard group, a more substantial relationship of .70 was shown. Mental age also showed moderate correlation, with an r of .66 for the multiple choice

TABLE 10

RELATIONSHIPS BETWEEN PROGRAMED SPELLING WORD GAINS & RELATED VARIABLES

B. INSTITUTIONAL GROUP

	PROGRAMED SPELLING WORDS KNOWN	
	Multiple Choice	Keyboard
Chronological Age	.40	.70
Mental Age	.66	.68
Programed Words Known on Pre-Test	-.06	.55
Programed Word Gain Pre-Test to Post-Test	.88	.44

group and .68 for the keyboard group. For the programed words known prior to the start of instruction, a negative but almost negligible relationship of -.06 exists for the multiple choice group; while for the keyboard group, a moderate relationship of .55 was shown. Conversely, the number of programed words learned during instruction showed a marked relationship to ability to learn the programed spelling for the multiple choice group, with an r of .88. For the keyboard method group, the relationship was approximately of the same order as for the public schools group, with an r of .44.

Reading in Context

A paragraph reading test (See Appendix B) to measure the ability of the subjects to read the programed words in context was designed by the experimenters. The test contained 44 of the 72 words

programed for the study. It was used as part of the immediate post-test battery for the multiple choice, keyboard, and tutorial groups.

In ability to read the programed words in context, the keyboard group subjects made slightly higher scores than those in both the multiple choice and tutorial groups, although no significant differences existed between groups. The keyboard group subjects were able to read a mean of 26.7 words in context as opposed to 25.9 words for the tutorial group, and 19.1 words for the multiple choice group. Examination of individual subject scores showed that ability to read in context varied positively with overall gains scores on programed words. Subjects with higher programed word gains had higher scores on the paragraph reading test, and those with low programed words gains did poorly on the paragraph reading test.

Behavioral Ratings

The Behavioral Rating Scale, constructed by the experimenters to assess behavioral characteristics associated with word recognition ability, was completed by classroom teachers and research assistants immediately following instruction. Ratings by research assistants and teachers were done only on the multiple choice group and keyboard group subjects, since the assistants had no contact with classroom subjects and since no change resultant of the experimental conditions was anticipated among classroom subjects. Means and standard deviations of the ratings by research assistants and by teachers are given in Appendix K.

Teachers' ratings of the experimental subjects were consistently below ratings by the research assistants; in only one case out of fourteen was the teachers' mean rating higher than that of the research assistants. Ratings of subject groups by both research

assistants and teachers suggested strong group similarities, although research assistants rated multiple choice subjects slightly higher than keyboard subjects, and teachers rated keyboard subjects slightly higher than multiple choice subjects.

Because of questionable reliability of the rating scales, statistical studies of differences were not done. For comparative purposes, however, mean behavioral ratings were calculated for the subjects falling in the highest quartile and subjects falling in the lowest quartile on the primary variable, programed word gains. These mean ratings, shown in Table 11, also show the research assistants' ratings to be uniformly higher than ratings by the subjects' teachers.

TABLE 11

MEAN BEHAVIORAL RATING FOR SUBJECTS WITH HIGHEST AND LOWEST PROGRAMED WORD GAIN

Characteristic	Teacher		Research Assistant	
	Q1	Q4	Q1	Q4
Personal Adjustment	2.72	2.63	2.72	3.36
Work Habits	2.00	2.27	2.45	3.09
Motivation	1.72	2.18	2.45	2.90
Direction Following Ability	2.45	2.63	2.81	3.00
Aspiration	2.00	2.63	2.54	3.18
Attention and Concentration	1.81	2.54	2.54	3.00
Maturity	1.90	2.45	2.18	2.45

Differences between the highest and lowest quartile of more than one-half a rating scale step were noted by the teachers on the factors: aspiration, attention and concentration, and maturity. Differences between the highest and lowest quartile noted by the research assistants were on the factors: personal adjustment, work habits, direction following ability, aspiration, and attention and concentration. Teachers and research assistants are in greatest agreement in rating: aspiration, attention and concentration.

In summary, the criteria for learning were analyzed in terms of word-recognition and spelling gains made by the public school and institutional samples during 8-week instructional periods. Retardates taught under both multiple choice and keyboard methods demonstrated significantly greater gains in learning these skills than did those taught under conventional classroom conditions. Retention of learned material was analyzed in terms of differences between both pre-instruction and post-instruction scores in word-recognition and spelling and scores obtained on 30 -day and 60-day post-tests. No significant differences in retention for word-recognition or spelling was observed between the three instructional methods. Substantial retention ratios, particularly for word-recognition were observed for both types of automated instruction.

CHAPTER IV

CONCLUSIONS AND COMMENTS

Hypothesis 1 states that no significant differences in efficiency will be found between automated teaching procedures and standard classroom instruction procedures for teaching spelling and reading to mental retardates. Results of the study provide grounds for rejection of this hypothesis. Subjects taught under both automated teaching procedures used in the study improved significantly in word recognition and spelling skills over those demonstrated by the standard classroom instruction group.

Hypothesis 2 states that effective retention of word recognition, reading, and spelling skills obtained in automated teaching procedures will be demonstrated by post-learning tests. This hypothesis is partially supported by the results of the study. Effective retention of word recognition skills obtained under both automated teaching procedures was demonstrated by scores on post-learning tests. Gains in programed words by the experimental groups remained significantly higher than gains by the classroom group at periods of 30 and 60 days following post-testing.

Retention of spelling skills obtained via automated instruction was more modest than that for word recognition. Approximately 50% of spelling words learned were retained for at least 30 days after instruction was terminated. Pre-instruction to 30-day post-test spelling achievement did not differentiate the experimental and the classroom groups. The evidence suggests that automated instruction like that provided in the study and, especially, like that provided by the typewriter keyboard apparatus used can

improve spelling skills of retardates over a relatively short time.

Hypothesis 3 states that no significant differences in learning and retention will be found between an automated teaching procedure utilizing multiple choice method and one using typewriter keyboard (modified completion) method. This hypothesis is partially supported by the results of this study. No significant differences were noted between the two methods except for pre-test to post-test gains for the programed words and on the pre-test to post-test scores on the Gates Primary Reading Test, Word Recognition section with the public schools group. No significant differences existed on these measures with the institutional groups and there were no significant differences at any point between methods in retention. In view of these findings, no unequivical conclusions can be reached with respect to Hypothesis 3.

Automated Instruction and Word Recognition

Perhaps the most important finding in the study was that, in every case, EMR pupils in experimental groups more than doubled the number of programed words known prior to automated instruction. Thus, in approximately ten hours of actual automated instruction spanning eight week periods, it was possible to double word recognition gains made in from four to ten years of public school classroom instruction. Less than 5 per cent of the classroom subjects used for control purposes doubled their word gains scores.

Both groups showed a very large percentage of words retained between post-instruction and 60-day post-test evaluations,

with the multiple choice group showing slightly larger proportions of words retained and the keyboard groups showing larger absolute numbers of words retained. Thus, both procedures were effective in helping retardates learn word recognition and permitted effective retention of this basic skill. The multiple choice group retained 88.8% of the words learned for 60 days and the keyboard group retained 77.4% of the words learned for 60 days. Retention of the order found in this study is rarely reported for retarded children. The high percentages of words recognized at the 60-day post-tests, and even the more modest retention scores for spelling, indicate that both automated procedures have promise for the functional education of retardates. It seems reasonable to conjecture that intermittent reinforcement of sight reading vocabulary and spelling gains could maintain reading and spelling skills for such subjects. Ss acted as if they were stimulated to attend more to classroom reading activities as a result of their exposure to automated instruction.

An attempt was made to relate potentially important variables to acquisition of word-recognition. Chronological age is moderately related to ability to profit from automated instruction for the Ss used in this study. Correlations from .37 to .75 were observed between CA and word recognition gains for the two samples of retardates. In particular, younger institutional Ss do not profit as much from multiple choice procedures as older Ss in both samples did from multiple choice and keyboard procedures. On the other hand, low order rs were observed between MA and word recognition, particularly for the public school Ss. The disparity in rs between CA and MA with word recognition may be a function of the ability of older retardates, regardless of MA, to attend better to a task requiring some perseverance. Other explanations are not readily apparent.

One further note should be made about automated instruction and word-recognition. Overall gains on the Gates Reading Test suggest that, at least for public school EMR children, the keyboard method might have greater value than the multiple choice procedure for teaching word-recognition. However, the small absolute raw score differences between the instructional groups and the fact that grade placement scores rather than raw scores are typically used for assessing reading programs by this test, indicate that caution must be used in making interpretation from these data. Relative to this, Stolurow (1961) noted that, among his automated instructional programs, there were low r's between achievement in automated learning and subtests of the California Achievement Test.

Automated Instruction and Spelling

The two automated teaching procedures produced gains in ability to spell which were significantly greater than the gains of the classroom group over the pre-test to post-test instruction period. Between methods, trend differences in favor of the keyboard procedure were observed for both public school and institutional samples at the termination of the learning period but were not significant at the 30-day post-test. It would appear that the keyboard method is somewhat better for promoting the learning of spelling skills but retention of learned spelling words is approximately the same under both automated procedures.

Institutional Ss showed higher mean gains in spelling than did the public school Ss, although there were no differences in numbers of words spelled correctly prior to instruction. Since institutional Ss were older and had somewhat higher MA's than the other sample, this may account for the differences in spelling achievement.

Moderate to substantial rs were observed between word-recognition and spelling gains for both samples. Such relationships might well be expected, since the pre-test word-recognition and spelling gains were also correlated (particularly for public school Ss). It would appear that ability to profit in spelling from automated instruction can be predicted reasonably well on the basis of spelling achievement level prior to instruction, at least for populations like those used in this study. More particularly, the requirements of the keyboard method commend it over the multiple choice method for teaching spelling to retardates, although the latter procedure is also moderately effective for this purpose.

Reading in Context

A paragraph reading test was used to assess the ability to read in context. The test contained 44 of the 72 programed words and was administered only to the multiple choice and keyboard groups following instruction.

Both groups showed significant gains in word recognition on these tests (19.1 words and 26.7 words respectively). Fluency of reading (i.e. reading without hesitation) was not objectively measured, but observational reports suggest that there was a relationship between number of words known and reading fluency. It seems reasonable to conclude that increase in word-recognition facilitates ability to read in context. Because of other considerations (e.g. getting equivalent base-lines in reading and spelling for the samples used, and in selecting non-readers as primary teaching targets), the study was unable to investigate this variable more thoroughly. It would be appropriate to do so in further studies.

Automated Versus Tutorial Instruction

It has been said that automated instruction is more similar to tutoring than any method yet devised. Both the human and mechanical "machines" can modify presentation and reinforcement conditions to suit response conditions of the individual; both can speed up or slow down as required; both can provide immediate feedback to the learner. Our results suggest that the "human machine" is somewhat superior in these functions to the automated instructional procedures used in this study, and particularly with respect to the multiple choice method.

Results of this study suggest that the "human teaching machine" is superior to one type of purely mechanical procedure used in this study. Individual tutoring produced significantly greater gains in word-recognition and spelling than did the multiple choice method. However, no significant differences were observed between the tutorial and keyboard methods.

It should be noted that human tutors reported some initial reticence on the part of the retarded Ss used in this part of the study. They speculated that this might be a function of response-generalization to the classroom situation. However, the reticence soon disappeared and Ss seemed to be strongly attracted to and reinforced by the human tutoring situation. These results would indicate, therefore, that the primary advantage of automated instruction is one of economy.

Variables Relevant to Automated Instruction

The Subjects

Selection of subjects meeting the criteria set originally

by the investigators proved somewhat more difficult than was anticipated. The matching variables of sex, chronological age, and mental age were chosen because of their probable correlation with ability to learn. The matching variables of programed words known and grade placement scores on the Gates Primary Reading Test, Word Recognition section were chosen in an attempt to match subjects in achievement.

Arbitrary limits set by the examiners required that scores on the Gates Word Recognition section fall between the 1.3 grade level and the 2.5 grade level of reading achievement. Because of these stringent criteria, subjects within the age range chosen were limited in number. It was quite frequently true that the subjects scoring within the desirable range on the Gates knew more than the arbitrary ceiling of 50 per cent of the programed words chosen as a cutoff point for subjects selection. The larger number of subjects meeting the selection creteria were found in the lower chronological age range. The oldest subject meeting the criteria was 15.9, while on the lower end of the scale all three groups had subjects at the minimum age of 10.0. The study might well be extended into the lower age ranges, since informal experimentation with subjects below the age criterion used in this study appeared to profit from automated procedures.

Teaching machine procedures were well accepted by both EMR pupils and teachers. Particularly during the early stages of the project, pupils were eager to volunteer to work on the teaching machines. Most of the pupils retained their enthusiasm throughout the two month period, even though it was observed that part of the novelty effect of the machine operation wore off after the first three or four weeks of instruction. In the latter half of the instructional period, students seemed to approach the teaching

machine sessions as regular school assignments and remained receptive to this type of learning throughout.

The Teaching Machines

Clearly, teaching machines possess attributes of patience and tolerance not ordinarily found among their human counterparts. In addition, they seem to possess an intrinsic attraction by virtue of their mechanization. At no time did the machines appear to present any operational or mechanical problems to the pupils used in this study. Even the youngest, chronologically or mentally, was capable of learning almost immediately the motor responses required for operation of the machines. Thus, the problem of obtaining a correct response appeared to be primarily an intellectual one. Breakdowns of equipment, while undesirable from the experimental standpoint, were unavoidable but they provided further observations of the subject's tolerance for working with mechanized equipment. Almost without exception, the subjects were interested in the machines and, when a breakdown occurred, they offered to assist in its repair. Occasionally the subject was able to effect an adjustment more quickly than the research assistant. Only a very few subjects showed hostile or withdrawal reactions when the breakdowns occurred.

None of the subjects in the study attempted to "cheat" the machines. For example, in the multiple choice machine group, none of the subjects randomly pushed all three buttons at one time in order to obtain the visual and auditory signal, although they were perfectly free to do so. Similarly the keyboard machine subjects did not press multiple keys. Had they chosen to do so, the opportunity to cheat on this machine was considerably restricted by a ratio of 1 to 36 right answer possibilities.

Although similar results in terms of teaching word recognition were obtained from both teaching procedures, it was felt by the experimenters that the simplicity of the semi-automated multiple choice machine offered more practical advantages for classroom use. Its less complex design and ease of operation made it preferable to the more complex electronic machine which had more breakdowns, sometimes requiring repair by electronic technicians. Instruction was not delayed during the study because of machine breakdown, since reserve machines were continuously available.

Problems of Analysis

One of the intrinsic advantages of the current study is its inherent value as an additional step in the analysis of various techniques of instruction. Experimental studies of instruction of retarded children are not numerous and in many instances they are lacking in adequate controls. Teaching machines increase the experimenter's control over the instructional process in a convenient and practical way. In addition, instructional studies of this nature provide, as Hively points out, "an appealingly concrete model for thinking about analysis and improvement of instructional process. They crystalize . . . an empirical experimental approach to teaching and learning which goes far beyond the usual vague notion of 'automated teaching.'" (Hively, 1961).

Numerous problems in analysis of the gains were encountered and considered. Among these was the presence of experimental subjects in the same classroom with the classroom control subjects. Only 31% of the experimental Ss used were enrolled in classes where classroom instruction was employed, although this obviously does constitute an uncontrolled variable. The possibility of subtracting classroom gains from automated method gains was considered. To do this would

require an assumption that the classroom group gains might be taken as an estimate of the gain occurring among all groups. This procedure was rejected because of the larger number of subjects who did not share classroom situations with control subjects, and because of the differences in instructional exposure. It should be kept in mind that, based upon mean age of the groups, the average public school subject had approximately six years of formal schooling prior to the less than ten hours of automated instruction; and, the average institutional subject had approximately nine years of formal schooling prior to the beginning of the automated instruction.

People who have worked extensively with mentally retarded subjects are aware of the extreme variability in test performance of this group. In this study, variation among the measures used was quite high, and gains of some subjects were remarkable because of their extreme limits. However, in both the public school and institutional settings, the patters of gains, the methods favored, and comparisons which were significantly different remained relatively constant between the public schools and institutional samples. These similarities existed in spite of the fact that the two samples were obtained in different cities, among groups of relatively different mental and chronological age, and were supervised by different research assistants.

In conclusion, the teaching machine procedures used in this study are not offered as universally effective with all retarded children. Students who could demonstrate word recognition vocabulary in excess of ten words on the pre-testing for programed words appeared to profit most from this type of presentation. Although a number of students who had no sight vocabulary of the programed words made small gains, these gains were very modest compared to the more

spectacular gains of subjects who knew greater percentages of words at pre-testing. The study did not evaluate the possibility that students knowing fewer words at pre-testing might have learned more words with either a slower rate of word presentation or greater reinforcement. There was some suggestion from experimentation during the validation of the program that this may be the case, however. Varying presentation and reinforcement conditions for teaching retarded children how to read and spell by means of automated instruction offers a promising field for further research.

Automated instruction seems to offer a practical method for dealing with some of the problems of teaching reading to the retarded. (1) The high gain scores in word recognition achieved by many of the subjects in this study suggests that many retardates might be capable of increasing their word recognition vocabulary considerably beyond the limits of the programs used in this study. (2) The methods used permit effective means for individualized instruction of retarded children. (3) In view of the encouraging results of this study, it would seem that further research to refine and extend programed instruction and automated teaching with the retarded is indicated.

APPENDICES

APPENDIX A

PROGRAMED AND NON-PROGRAMED WORDS

(In Order of Presentation in Programs)

Programed Words				Non-Programed Words	
cat *	hand	jump *	cake	nut *	rat
tree	girl	six	pencil	your	fly
box	ball *	he	dress *	were	make
cow	three	she	eight	bear	fan *
sun *	eat	over *	nine	get	paint
house	school	sleep	letter	drop *	floor
dog	window *	in	sing *	read	coat
book	run	dish	under	bag	see *
car *	four	star *	knife	monkey	rake
bed	train	watch	play	flower *	egg
chair	leaf *	truck	ten *	fire	can
man	money	door	cent	pony	yes *
one *	drink	seven *	fork	smoke	from
the	five	walk	candy	clock *	put
two	women *	fish	write *		
table	on	ship	teacher		
bird *	rain	eye *	milk		
boy	airplane	work	moon		

* Spelling Words

APPENDIX B

PARAGRAPH READING TEST

A CAT IS IN THE BOX.
THE GIRL HAS A BALL.
THE BALL IS IN HER HAND.
A COW GIVES MILK.
A WOMAN IS ON THE TRAIN.

MORNING

IT IS MORNING!
THE SUN IS SHINING.
THE MAN IS BRINGING THE MILK IN HIS TRUCK.
THE BIRDS SING UNDER THE TREE NEAR THE HOUSE.
THE BOY'S WATCH SAYS SEVEN.
HE MUST GET OUT OF BED TO DRESS AND EAT.

ON THE TABLE IS A KNIFE AND FORK, ONE DISH, AND A GLASS OF MILK.
MOTHER WILL SOON WALK IN THE DOOR WITH BREAKFAST.
THE BOY'S DOG RUNS OVER TO HIM AND JUMPS UP ON HIM.
IT WANTS TO PLAY.
BUT THE BOY MUST DRINK HIS MILK.
HE MUST GET HIS PENCIL AND BOOK.
IT IS TIME TO GO TO SCHOOL.
THE TEACHER IS WAITING.

APPENDIX C

BEHAVIORAL RATING SCALE

Name of Subject_____ Subject Number_____

School_____ Method_____

Name of Rater_____ Date_____

Personal Adjustment

Severe emotional maladjustment, psychotic, pre-psychotic, or markedly neurotic	Emotional maladjustment or disturbed; usually a behavior problem, aggressive, or withdrawn	Fair emotional adjustment, some problems or disturbance; mild interference with performance ability	Good adjustment, well compensated
1	2	3	4

Work Habits

Poor work habits; low organizational ability; not self starter, needs constant assistance and supervision	Fair work habits, slow starter, fair work organization, assistance and supervision needs greater than average	Normal work habits, normal progress in work assignments, organizational ability normal for age	Better than average work habits, self starter, good sustained effort, better than average progress on most assignments
1	2	3	4

Motivation

Active or passive resistance; apathy; slow, uninterested performance; needs constant prodding or persuasion	Low motivation, needs occasional prodding, support, or extra attention	Normal motivation for age, requires some support but ordinarily willing to perform	Highly motivated, anxious to achieve
1	2	3	4

Direction Following Ability

Little or no ability to follow concrete directions	Poor ability to carry out concrete directions	Normal or average ability to follow concrete directions	Good direction following ability; better than average
1	2	3	4

Aspiration

Expectations totally unrealistic, poorly oriented to practical reality	Expectations somewhat unreal, reluctant to abandon own goals for more realistic objectives, poor capacity for change	Aspirations somewhat impractical; tends to adjust with guidance	Realistic aspirations, good reality appraisal, cooperative in adjustment process; has practical goals
1	2	3	4

Attention and Concentration

Poor attention and concentration span, little or no ability to sustain attention or effort at a given task	Low attention and concentration span, lower than average ability to maintain effort	Average attention and concentration relative to total group	Better than average attention and concentration; can sustain effort longer than average
1	2	3	4

Maturity

Very dependent; childlike; highly demanding; cannot postpone gratifications; little foresight	Mildly immature, some dependency; poor postponement of gratifications; less than average foresight	Average maturity for group; mostly self dependent; average foresight; fairly good self control	Better than average maturity for group; relatively independent; beginnings of adult-like reactions; ability to postpone gratifications in favor of future goals
1	2	3	4

APPENDIX D

GAIN AND RETENTION OF INDIVIDUAL SUBJECTS**

Public Schools Sample

Subjects	MULTIPLE CHOICE			KEYBOARD			CLASSROOM		
	Word Gains Pre-to Post	Retained at 30 Days	Retained at 60 Days	Word Gains Pre-to Post	Retained at 30 Days	Retained at 60 Days	Word Gains Pre-to Post	Retained at 30 Days	Retained at 60 Days
1	40	33	32	39	37	40	0	0	*
2	23	20	16	30	11	8	5	6	5
3	9	10	*	28	27	*	0	0	0
4	13	8	7	31	24	20	11	10	12
5	12	7	12	2	3	3	2	3	4
6	34	14	20	26	13	22	4	3	3
7	13	12	19	8	2	11	0	1	2
8	7	3	4	33	21	22	-1	-1	0
9	2	0	0	4	4	5	2	8	7
10	29	23	21	16	13	16	-6	-6	-5
11	9	4	*	22	22	*	0	0	0
12	26	21	24	25	21	18	20	27	23
13	43	36	37	33	22	12	3	6	6
14	15	22	19	46	34	46	9	15	17
15	27	14	27	35	34	36	0	1	1
16	21	19	16	34	20	19	6	6	5
17	35	18	25	24	19	23	5	10	13
18	8	10	14	30	25	29	7	9	-3
19	15	18	14	42	25	29	1	0	0
20	29	15	24	41	28	*	0	0	*
21	6	0	0	36	18	19	1	-1	2
22	34	29	33	34	28	35	12	18	23

* Subjects not available.
** On 72 word list of programed words

APPENDIX E

GAIN AND RETENTION OF INDIVIDUAL SUBJECTS**

Sunland Training Center

Subjects	MULTIPLE CHOICE		KEYBOARD		CLASSROOM	
	Word Gains Pre-to Post	Retained at 30 Days	Word Gains Pre-to Post	Retained at 30 Days	Word Gains Pre-to Post	Retained at 30 Days
1	24	18	10	13	1	7
2	4	3	10	8	1	2
3	4	2	3	-4	3	5
4	18	17	16	20	1	3
5	17	20	16	14	-3	1
6	48	50	15	17	5	6
7	2	7	25	16	0	1
8	9	10	10	7	-3	-2
9	14	8	28	34	-1	-2
10	3	*	16	14	1	*
11	30	18	11	9	1	*

* Subjects not available
** On 72 word list of programed words

APPENDIX F

WORD GAINS FOLLOWING INSTRUCTION

PUBLIC SCHOOLS SAMPLE

	Standard Deviation		
	Multiple Choice	Keyboard	Classroom
Programed Words (N=72)			
Pre-Test to Post-Test	11.70	11.57	5.57
Pre-Test to 30 Day Post-Test	9.71	9.88	7.45
Pre-Test to 60 Day Post-Test	10.04	11.48	7.71
Programed Spelling Words (N=18)			
Pre-Test to Post-Test	3.30	6.86	1.12
Pre-Test to 30 Day Post-Test	1.86	3.85	1.71
Non-Programed Words (N=28)			
Pre-Test to Post-Test	2.79	5.62	2.39
Pre-Test to 30 Day Post-Test	2.09	5.46	2.61
Pre-Test to 60 Day Post-Test	2.10	6.31	2.74
Non-Programed Spelling Words (N=7)			
Pre-Test to Post-Test	.93	1.88	.45
Pre-Test to 30 Day Post-Test	.97	.17	.73
Gates Word Recognition Test			
Pre-Test to Post-Test	7.54	8.47	5.49
Pre-Test to 30 Day Post-Test	6.72	8.19	9.79

APPENDIX G

WORD GAINS FOLLOWING INSTRUCTION

SUNLAND TRAINING CENTER

	Standard Deviation		
	Multiple Choice	Keyboard	Classroom
Programed Words (N=72)			
Pre-Test to Post-Test	13.49	6.87	2.42
Pre-Test to 30 Day Post-Test	13.11	6.45	2.59
Programed Spelling Words (N=18)			
Pre-Test to Post-Test	10.29	4.84	-
Pre-Test to 30 Day Post-Test	9.18	4.34	-
Non-Programed Words (N=28)			
Pre-Test to Post-Test	2.66	2.51	3.07
Pre-Test to 30 Day Post-Test	3.24	1.91	2.21
Non-Programed Spelling Words (N=7)			
Pre-Test to Post-Test	1.73	.83	-
Pre-Test to 30 Day Post-Test	1.95	1.31	-
Gates Word Recognition Test			
Pre-Test to Post-Test	4.88	3.58	5.33
Pre-Test to 30 Day Post-Test	4.93	5.45	5.24

APPENDIX H

SIMPLE ANALYSIS OF VARIANCE - PROGRAMED WORD GAIN

Public Schools Sample

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	2	6903.6	3451.8	32.49*
	Within Gps.	63	6693.6	106.2	
	Total	65	13597.2		
Pre-Test to 30 Day Post-Test	Between Gps.	2	1831.1	915.6	10.54*
	Within Gps.	56	4861.1	86.8	
	Total	58	6692.2		
Pre-Test to 60 Day Post-Test	Between Gps.	2	2566.5	1283.2	12.52*
	Within Gps.	56	5738.8	102.5	
	Total	58	8305.3		

Sunland Training Center

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	2	1510.4	755.2	8.75*
	Within Gps.	30	2587.2	86.2	
	Total	32	4097.6		
Pre-Test to 30 Day Post-Test	Between Gps.	2	1302.2	651.1	10.19*
	Within Gps.	27	1724.2	63.9	
	Total	29	3026.4		

* significant at .01 level

** significant at .05 level

Programed Word Gain (Cont.)

Matched Groups

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	3	5601.1	1867.0	13.84*
	Within Gps.	36	4853.5	134.8	
	Total	39	10454.6		
Pre-Test to 30 Day Post-Test	Between Gps.	3	1843.9	614.6	6.53*
	Within Gps.	36	3386.3	94.1	
	Total	39	5230.2		

SIMPLE ANALYSIS OF VARIANCE - PROGRAMED SPELLING GAIN

Public Schools Sample

	Source	df	S	MS	F
Pre-Test to Post-Test	Between Gps.	2	316.6	158.3	11.93*
	Within Gps.	62	822.4	13.3	
	Total	64	1139.0		
Pre-Test to 30 Day Post-Test	Between Gps.	2	25.5	12.8	1.73
	Within Gps.	56	411.2	7.3	
	Total	58	436.7		

* significant at .01 level

** significant at .05 level

Programed Spelling Gain (Cont.)

Matched Groups

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	3	280.2	93.4	5.60*
	Within Gps	36	599.4	16.7	
	Total	39	879.6		

SIMPLE ANALYSIS OF VARIANCE - NON-PROGRAMED WORD GAIN

Public Schools Sample

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	2	154.8	77.4	4.92**
	Within Gps.	63	991.4	15.7	
	Total	65	1146.2		
Pre-Test to 30 Day Post-Test	Between Gps.	2	54.2	27.1	1.92
	Within Gps.	56	787.6	14.1	
	Total	58	841.8		
Pre-Test to 60 Day Post-Test	Between Gps.	2	87.0	43.5	2.44
	Within Gps	56	996.0	17.8	
	Total	58	1083.0		

* significant at .01 level

** significant at .05 level

Non-Programed Word Gain (Cont.)

Sunland Training Center

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	2	15.9	8.0	1.67
	Within Gps.	28	133.7	4.8	
	Total	30	149.6		
Pre-Test to 30 Day Post-Test	Between Gps.	2	11.3	5.7	.76
	Within Gps.	28	207.8	7.4	
	Total	30	219.1		

Matched Groups

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	3	397.1	132.4	3.45**
	Within Gps.	36	1377.9	28.3	
	Total	39	1775.0		
Pre-Test to 30 Day Post-Test	Between Gps.	3	128.9	43.0	2.08
	Within Gps.	36	742.5	20.6	
	Total	39	871.4		

* significant at .01 level

** significant at .05 level

SIMPLE ANALYSIS OF VARIANCE - NON-PROGRAMED SPELLING GAIN

Public Schools Sample

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	2	14.7	7.4	5.45*
	Within Gps.	61	82.9	1.4	
	Total	63	97.6		
Pre-Test to 30 Day Post-Test	Between Gps.	2	2.2	1.1	.13
	Within Gps.	60	51.4	8.6	
	Total	62	53.6		

Matched Groups

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	3	11.9	3.9	1.71
	Within Gps.	36	83.1	2.3	
	Total	39	95.0		

* significant at .01 level

** significant at .05 level

SIMPLE ANALYSIS OF VARIANCE - GATES RAW SCORE GAIN

Public Schools Sample

	Source	df	SS	MS	F
Pre-Test to Post-Test	Between Gps.	2	715.9	358.0	6.42*
	Within Gps.	63	3512.5	55.8	
	Total	65	4228.4		
Pre-Test to 30 Day Post-Test	Between Gps.	2	219.3	109.6	1.49
	Within Gps.	56	4101.5	73.2	
	Total	58	4320.8		

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Pre-Test to Post-Test	Between Gps.	2	1.0	.5	.02
	Within Gps.	30	715.2	23.8	
	Total	32	716.2		
Pre-Test to 30 Day Post-Test	Between Gps.	2	50.3	25.2	.83
	Within Gps.	27	818.3	30.3	
	Total	29	868.6		

Matched Groups

Pre-Test to Post-Test	Between Gps.	2	978.4	489.2	7.09*
	Within Gps.	36	2483.4	69.0	
	Total	38	3461.8		

* significant at .01 level

** significant at .05 level

APPENDIX I

t RATIOS BETWEEN TREATMENT GROUP MEANS

Public Schools Sample

Programed Words - Pre-Test to Post-Test

	Keyboard	Classroom
Multiple Choice	2.12**	5.88*
Keyboard		8.81*

Programed Words - Pre-Test to 30 Day Post-Test

	Keyboard	Classroom
Multiple Choice	1.12	3.67*
Keyboard		4.87*

Programed Words - Pre-Test to 60 Day Post-Test

	Keyboard	Classroom
Multiple Choice	1.00	4.26*
Keyboard		5.00*

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Programed Words - Pre-Test to Post-Test

	Keyboard	Classroom
Multiple Choice	.25	3.50*
Keyboard		6.06*

Programed Words - Pre-Test to 30 Day Post-Test

	Keyboard	Classroom
Multiple Choice	.80	2.74**
Keyboard		3.42*

*significant at .01 level ** significant at .05 level

Matched Group

Programed Words - Pre-Test to Post-Test			
	Keyboard	Tutorial	Classroom
Multiple Choice	1.53	1.81	4.42*
Keyboard		.37	6.60*
Tutorial			6.53*

Programed Words - Pre-Test to 30 Day Post-Test			
	Keyboard	Tutorial	Classroom
Multiple Choice	1.43	.70	2.96*
Keyboard		.75	4.25*
Tutorial			3.77*

Public Schools Sample

Programed Spelling Words - Pre-Test to Post-Test		
	Keyboard	Classroom
Multiple Choice	1.69	3.35*
Keyboard		3.50*

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Programed Spelling Words - Pre-Test to Post-Test	
	Keyboard
Multiple Choice	.52

Programed Spelling Words - Pre-Test to 30 Day Post-Test	
	Keyboard
Multiple Choice	1.52

*significant at .01 level ** significant at .05 level

Matched Group

Programed Spelling Words - Pre-Test to Post-Test			
	Keyboard	Tutorial	Classroom
Multiple Choice	1.72	.91	2.09**
Keyboard		2.13**	3.59*
Tutorial			1.48

Public Schools Sample

Non-Programed Words - Pre-Test to Post-Test		
	Keyboard	Classroom
Multiple Choice	1.70	1.88
Keyboard		2.87*

Matched Group

Non-Programed Words - Pre-Test to Post-Test			
	Keyboard	Tutorial	Classroom
Multiple Choice	1.98	2.05**	1.00
Keyboard		.37	2.47**
Tutorial			2.44**

Public Schools Sample

Non-Programed Spelling Words - Pre-Test to Post-Test		
	Keyboard	Classroom
Multiple Choice	1.99	1.87
Keyboard		3.32*

*significant at .01 level

** significant at .05 level

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Non-Programed Spelling Words - Pre-Test to Post-Test	
	Keyboard
Multiple Choice	.46

Non-Programed Spelling Words - Pre-Test to 30 Day Post-Test	
	Keyboard
Multiple Choice	.30

Matched Group

No Significance

Public Schools Sample

Gates Raw Score - Pre-Test to Post-Test		
	Keyboard	Classroom
Multiple Choice	3.26*	2.39**
Keyboard		1.45

Matched Group

Gates Raw Score - Pre-Test to Post-Test			
	Keyboard	Tutorial	Classroom
Multiple Choice	1.82	2.64**	1.17
Keyboard		.75	.79
Tutorial			1.81

*significant at .01 level

** significant at .05 level

APPENDIX J

COMPARISON OF MATCHED GROUP PERFORMANCE

STANDARD DEVIATIONS

	Multiple Choice (N=10)	Keyboard (N=10)	Classroom (N=10)	Tutorial (N=10)
	S.D.	S.D.	S.D.	S.D.
Programed Words				
Pre-Test to Post-Test	12.30	11.94	4.10	13.20
Pre-Test to 30 Day Post-Test	9.71	10.48	6.06	9.82
Programed Spelling Words				
Pre-Test to Post-Test	4.11	5.79	1.32	2.75
Non-Programed Words				
Pre-Test to Post-Test	2.52	6.96	2.11	8.85
Pre-Test to 30 Day Post-Test	1.63	6.90	1.73	4.96
Non-Programed Spelling Words				
Pre-Test to Post-Test	1.09	2.33	.89	.92
Gates Word Recognition Test				
Pre-Test to Post-Test	7.96	9.49	6.39	9.29

APPENDIX K

COMPARISON OF BEHAVIORAL RATINGS BY EXPERIMENTERS

	MULTIPLE CHOICE		KEYBOARD	
Rating Factor	Mean	S.D.	Mean	S.D.
Personal Adjustment	3.04	.59	3.09	1.24
Work Habits	2.86	.88	2.54	1.08
Motivation	2.86	.71	2.63	.99
Direction Following	3.04	.51	2.09	1.01
Aspiration	2.81	.91	2.95	.99
Attention and Concentration	3.00	.67	2.63	.99
Maturity	2.59	.78	2.45	.85

COMPARISON OF BEHAVIORAL RATINGS BY TEACHERS

	MULTIPLE CHOICE		KEYBOARD	
Rating Factor	Mean	S.D.	Mean	S.D.
Personal Adjustment	2.81	.69	2.63	.79
Work Habits	2.04	1.12	2.54	.74
Motivation	2.00	.85	2.09	.67
Direction Following	2.45	.79	2.45	.73
Aspiration	2.50	.89	2.54	.95
Attention and Concentration	2.27	.92	2.22	.92
Maturity	2.27	.69	2.09	.80

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